Enhanced Low Dose Rate Effects in Bipolar Circuits: A New Hardness Assurance Problem for NASA

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ABSTRACT

Recently, it has been established that many bipolar integrated circuits are much more susceptible to ionizing radiation at low dose rates (0.001 to 0.005 rad(Si)/sec) than they are at the high dose rates (50 to 300 rad(Si)/sec) typically used for radiation testing of parts in the laboratory. Since the low dose rate regime is equivalent to that encountered in space, for these devices the standard laboratory radiation test at moderate to high dose rates is no longer conservative. The seriousness of this problem has led the Air Force to issue an Alert Concern for this effect. Because of the greater radiation sensitivity at very low dose rates, the only way to provide radiation hardness assurance (RHA) to designers is to perform a radiation test at low dose rates which by its nature is very time consuming. Consequently, it is imperative that an RHA test be developed which can be performed at moderate to high dose rates. Because the physical mechanism for the enhanced low dose rate effect is not completely understood, it is not yet possible to propose a reliable RHA test. In this presentation, we will provide examples of this effect, which serve to emphasize the seriousness of the enhanced low dose rate susceptibility problem. We will then discuss possible mechanisms for the low dose rate enhancement and hardness assurance tests suggested by these mechanisms.